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New records of *Bilimbia* and *Toninia* from China

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Abstract—As a result of our study on the lichen flora of Northwest China, one species of *Bilimbia* (*B. lobulata*) and three species of *Toninia* (*T. coelestina, T. gobica,* and *T. superioris*) are reported for the first time from China.

Keywords—Asia, biodiversity, *Lecanorales*, *Ramalinaceae,* taxonomy

Introduction

Bilimbia De Not. and *Toninia* A. Massal. belong to *Ramalinaceae* C. Agardh (*Lecanorales*), a widely distributed lichen family (Ekman 2001, Ekman & al. 2008).

Bilimbia is distinguished from *Bacidia*, *Biatora,* and *Mycobilimbia* by the stout paraphyses and ascospores often surrounded by a finely warted perispore (Smith & al. 2009, Veldkamp 2004.).

Toninia was described by Massalongo (1852) originally based on ascospore morphology as well as on characters of apothecia and thallus. Today it is additionally diagnosed by the asci and paraphyses. The asci are *Bacidia*-type, clavate. The paraphyses are usually straight and rarely branched (except at the tips), with apical cells that are distinctly swollen and usually capped with gelatinous pigment. Epithecial pigments that also characterize *Toninia* include grey (K+ violet, N+ violet), bright green (K–, N+ violet), olivaceous green (K+ violet/brown, N–), reddish brown (K+ red, N–), and dull brown (K–, N–) (Timdal 1991, 2002; Zahlbruckner 1890).

Here we report one species of *Bilimbia* (*B. lobulata*) and three species of *Toninia* (*T. coelestina, T. gobica,* and *T. superioris*) for the first time from China.

Materials & methods

The specimens studied are deposited in the Lichen Section, Botanical Herbarium, Shandong Normal University, Jinan, China (SDNU), and the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China (HMAS-L). The specimens were examined morphologically under an Olympus SZ stereo-microscope and Olympus CX21 polarizing microscope. Thalli and medullae were tested for identification with K (potassium hydroxide, 10% aqueous solution), C (sodium hypochlorite, saturated aqueous solution), I (potassium iodide, 10% aqueous solution), N (10% nitric acid), and P (saturated solution of *p*-phenylenediamine in 95% ethyl alcohol). Lichen substances were identified using standardized thin layer chromatography (TLC) techniques with system C (Orange & al. 2001). The lichens were digitally photographed under Olympus SZX16 and BX61 with DP72.

Taxonomic descriptions

Bilimbia lobulata (Sommerf.) Hafellner & Coppins,
Lichenologist 36: 195 (2004) Fig. 1

Thallus warted-granular to squamulose, squamules ≤0.6 mm wide, continuous, ±overlapping, yellowish white; Apothecia ≤1 mm diam., lecideine, black, sessile, flat to slightly convex, epruinose to faintly pruinose; Proper exciple reddish brown (similar to hypothecium), K+ intensifying or reddish purple; Epihymenium ≤15 µm high, olive green, K–, N+ reddish; Hymenium 70–85 µm high, colourless to dull reddish brown; Subhymenium 25–40 µm high, usually colourless; Paraphyses conglutinated, simple or slightly branched, 2–3.5 µm diam. with apical cell distinctly swollen ≤5 µm diam.; Ascospores medium fusiform, (0–)2–3-septate, 15–20 × 3–5 µm.

Chemistry—Cortex and medulla K–, C–, KC–; Zeorin detected by TLC.

Specimens examined: **CHINA. Qinghai: Qilian,** Niuxinshan, alt. 3500 m, on soil, 11 Aug. 2007, 11 Aug. 2007, J.G. Liu 20071633 (SDNU); **Shanxi: Niingwu,** Luyashan, alt. 2500 m, on soil, 26 Aug. 2011, H.Y. Wang 20121675 (SDNU).

Distribution—Europe, North America, Antarctica, Asia (Smith & al. 2009, Urbanavichus 2010). New to China.

Comments—The Chinese material closely matches the previously published description by Hafellner & al. (2004). *Bilimbia lobulata* is

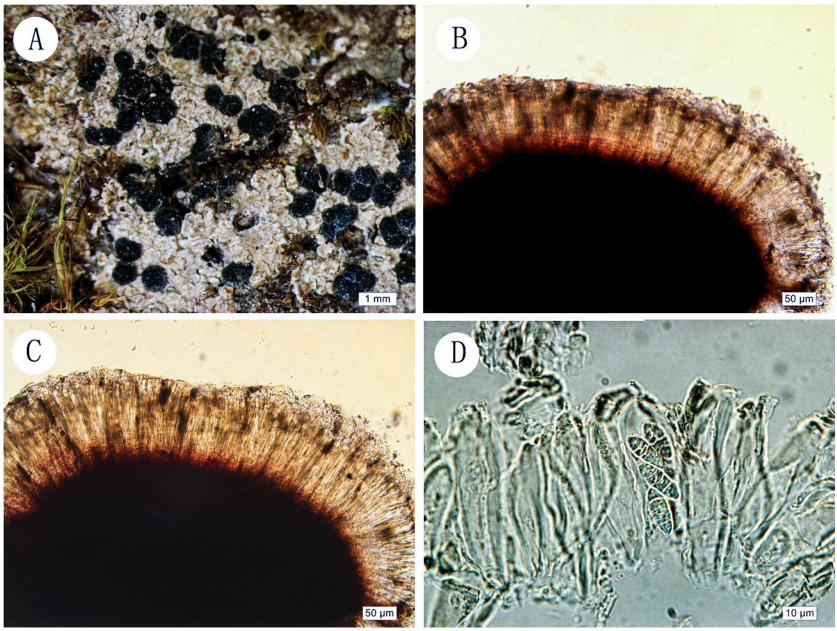

Fig. 1. *Bilimbia lobulata* (SDNU 20071633). A. Thallus and apothecia; B. Apothecium section; C. Apothecium section (showing epihymenium K+ reaction); D. Ascospores with three septa. Scale bars: A = 1 mm; B, C = 50 µm; D = 10 µm.

distinguished from *B. sabuletorum* (Schreb.) Arnold, which has a crustose thallus, and longer, 3–7(–9)-septate ascospores (Smith & al. 2009).

Toninia coelestina (Anzi) Vězda,
Čas. Slez. Mus., Ser. A, Hist. Nat. 10: 105 (1961) Fig. 2

Thallus crustose to subsquamulose, continuous to warty, granules present; upper side pale yellowish brown to greyish brown, epruinose, without pores and pseudocyphellae; Apothecia 0.75–1.5 mm diam., epruinose, when young flat and mostly marginate, when mature mostly weakly convex and immarginate; Proper exciple grayish black on the rim, dark brown in inner part, K–, N+ violet; Hypothecium dark brown; Hymenium 50–65 µm high; Epithecium dark olive green, K–, N+ violet; Paraphyses simple or slightly branched at the tip, 2–3.5 µm diam. with apical cell swelling ≤4.5 µm diam.; Ascospores narrowly ellipsoid to bacilliform, 3–7-septate, 17.5–37.5 × 2.5–3.5 µm.

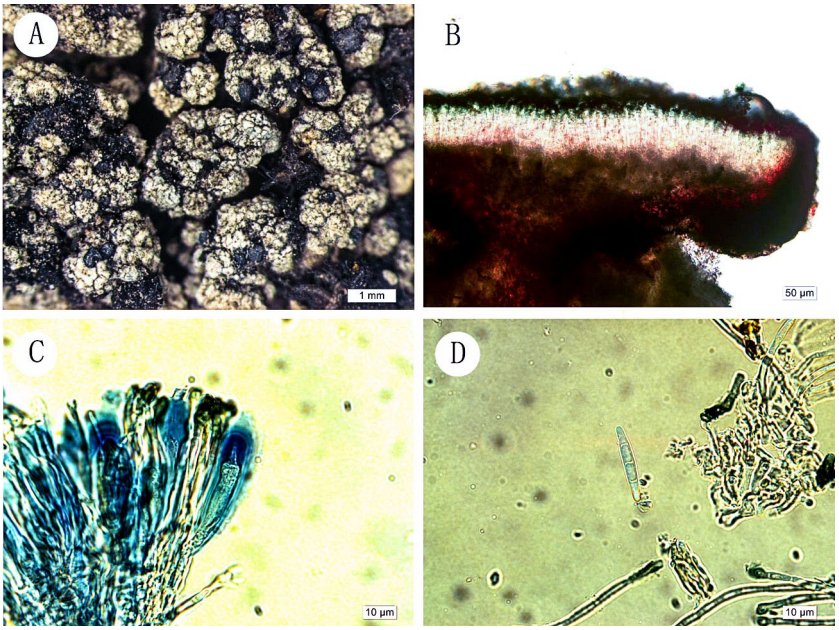

Fig. 2. *Toninia coelestina* (SDNU 20126519a). A. Thallus with apothecia; B. Apothecium section; C. Asci: Bacidia-type; D. Ascospore with three septa. Scale bars: A = 1 mm; B = 50 µm; C, D = 10 µm.

Chemistry—Cortex and medulla K–, C–, KC–. Terpenoids detected by TLC.

Specimen examined: **CHINA. Xinjiang: Tianshan,** Yihaobingchuan, alt. 2480 m, on soil, 26 Aug. 2011, L. Li 20126519a (SDNU).

Distribution—Europe: Austria, Italy, Norway, Poland, Scotland, Slovakia (Flakus 2007, Timdal 1991, van den Boom & al. 1996, Vězda A. 1961). New to China.

Comments—The Chinese material closely matches previously the published description by Vězda (1961). *Toninia coelestina* closely resembles *T. thiopsora* (Nyl.) H. Olivier, which differs by its 7-septate ascospores and its C+ orange thallus (Smith & al. 2009).

Toninia gobica N.S. Golubk., Bot. Zhurn. SSSR 58(6): 838 (1973) Fig. 3

Thallus squamulose, squamules ≤3 mm diam., scattered to contiguous, slightly to strongly convex, weakly pruinose, dull yellow, without pseudo-

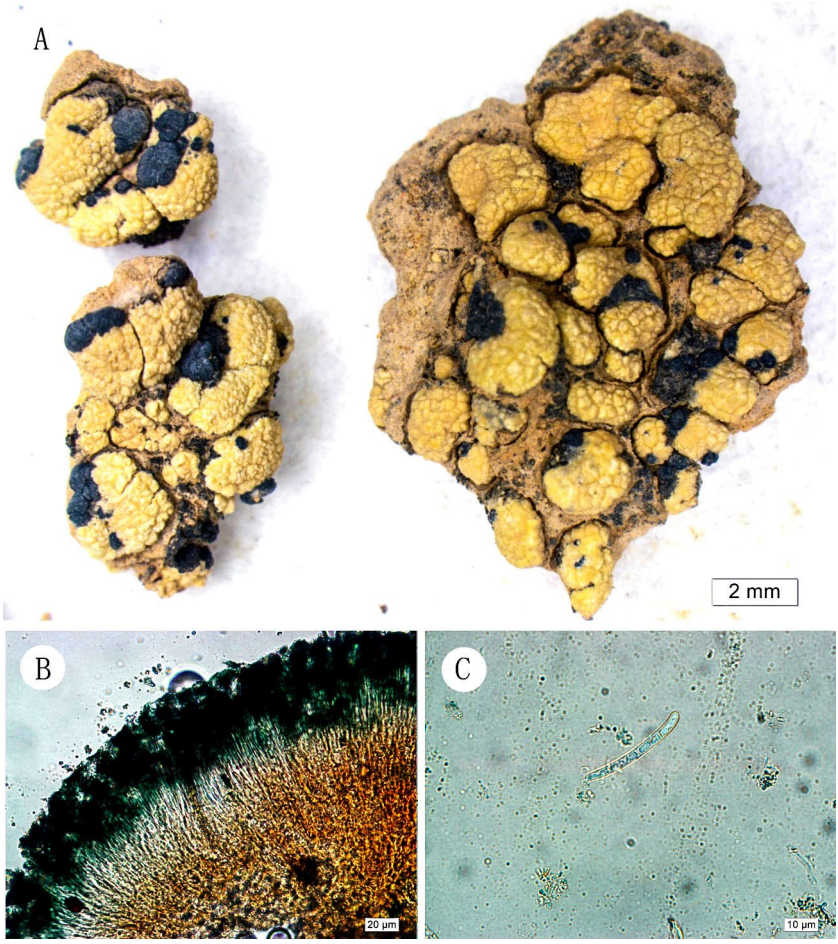

Fig. 3. *Toninia gobica* (HMAS-L 121615). A. Thalli with apothecia; B. Apothecium section; C. Ascospore with three septa. Scale bars: A = 2 mm; B = 20 µm; C = 10 µm.

cyphellae, mostly rimose on the surface; Apothecia ≤1 mm diam., flat to strongly convex, usually on the edge of thallus, epruinose to slightly pruinose; Proper exciple dark brown in inner part, K–, N–; Hypothecium dull yellowish brown or colourless; Hymenium 60–70 µm high; epithecium bright green, K–, N+ violet; Ascospores acicular, 3-septate, 30–45 × 3–5 µm.

Chemistry—Cortex and medulla K–, C–, KC–. Terpenoids detected by TLC.

Specimens examined: **CHINA. Ningxia: Zhongwei,** Shapotou, Cuiliugou, alt. 1200 m, on soil, 9 Apr. 2010, T. Zhang 121615 (HMAS-L); **Neimenggu: Wulatehouqi,** Huhebashige, alt. 1600 m, on rock, 19 Aug. 2011, H.Y. Wang 20122753 (SDNU).

Distribution—Mongolia (Golubkova 1973, Timdal 1991). New to China.

Comments—The Chinese material closely matches the type description by Golubk (1973). *Toninia gobica* and *T. lutosa* (Ach.) Timdal both have regular fissures on the thallus, but *T. lutosa* has deeper fissures and also differs by its dark reddish brown epithecium and shorter, K+ red, N–, (1–)3-septate ascospores (Timdal 1991).

Toninia superioris Timdal, Opera Bot. 110: 103 (1991) Fig. 4

≡ *Kiliasia superioris* (Timdal) Timdal, in Kistenich & al., Taxon 67(5): 893 (2018)

Thallus squamulose, squamules ≤1 mm diam., imbricate or contiguous, orbicular to irregular, flat to slightly convex, pruina present or absent, whitish grey, fissures and pseudocyphellae absent; Apothecia ≤1mm diam., flat to slightly convex, marginate or immarginate, faintly pruinose; Proper exciple grey on the rim, paler grey to colourless in the inner part, K+ violet, N+ violet; Hypothecium colourless to pale brown; Epithecium grey, K+ violet, N+ violet; Ascospores narrowly or broadly fusiform, mainly 3-septate, 12.5–20 × 3.5–5 μm.

Chemistry—Cortex and medulla K–, C–, KC–. Terpenoids detected by TLC.

Specimen examined: **CHINA. Neimenggu: Keqi,** Huangganglian, alt. 2000 m, on soil, 13 Aug. 2011, H.Y. Wang 20117397 (SDNU).

Distribution—U.S.A.: Michigan (Timdal 1991). New to China.

Comments—The Chinese material closely matches the type description by Timdal (1991). *Toninia superioris* resembles *T. hosseusiana* Gyeln., which differs by its dark reddish brown epithecium and proper exciple (K+ red, N–), and its ≤3 mm diam. thalline squamules covered with farinose pruina (Gyelnik 1942, Timdal 1991).

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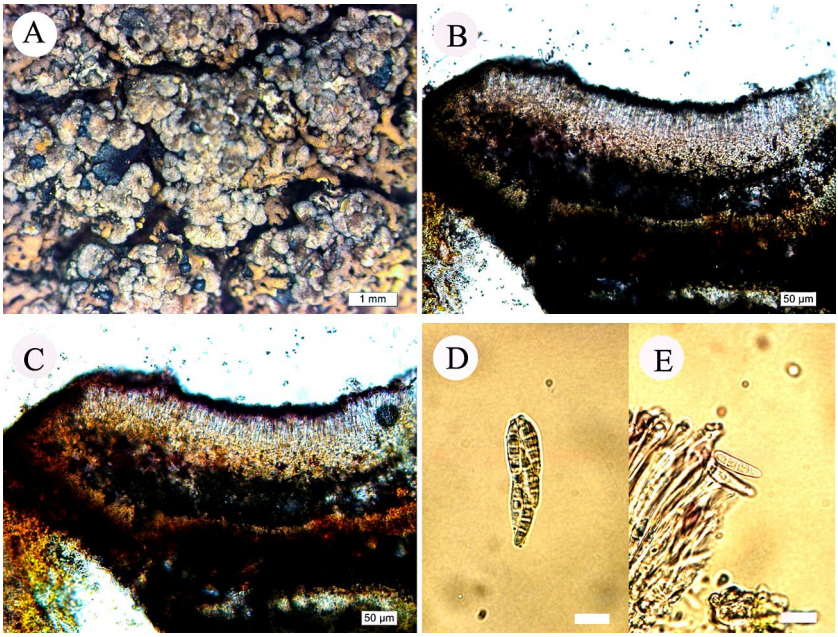

Fig. 4. *Toninia superioris* (SDNU 20117397). A. Thallus and apothecia; B. Apothecium section; C. Apothecium section (showing epihymenium K+ reaction); D, E. Ascospores with three septa. Scale bars: A = 500 µm; B, C = 20 µm; D, E = 10 µm.

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